PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-200167
(43)Date of publication of application : 31.07.1997

(51)Int.Cl. H04J 3/00
H04B 10/02
H04J 3/04
H04L 7/08

(21)Application number : 08-006312
(22)Date of filing : 18.01.1996

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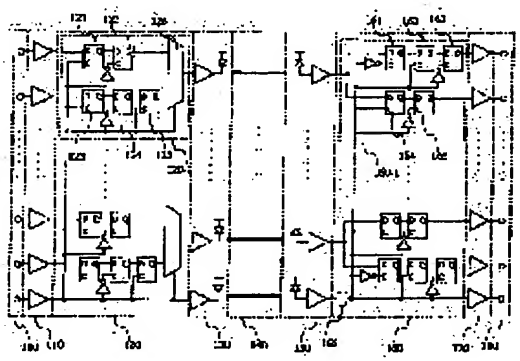
(54) SYSTEM AND DEVICE FOR OPTICAL PARALLEL TRANSMISSION

(57)Abstract:
PROBLEM TO BE SOLVED: To eliminate the need for an external high speed clock supply source and a clock multiplier circuit by configuring a multiplexer circuit and a demultiplexer circuit with a specific latch circuit and a selector only.
SOLUTION: Input data signals D0, D1 at a transmission speed whose phases are not coincident are latched at a trailing of a clock signal by D latches 121–124 of a multiplexer circuit to make the phases are matched with each other. The data signal D1 is latched at a rising of a clock signal by a latch 125 and the phase of the signal D1 is delayed by 1/2-bit. Outputs of the D latches 123, 125 depend on the level of the clock signal by a selector 126. Then one data signal distributed by a demultiplexer circuit is latched by a trailing of a clock signal at D latches 164, 165 and the other data signal is latched at a leading of the clock signal by D latches 161, 162. Furthermore, an output signal of the D latch 162 is latched at a trailing of the clock signal by using the D latch 163 to recover the signals D0, D1 whose phases are arranged.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] In an optical transmitter, the clock signal of frequency f [Hz] and the signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with said clock signal are considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission outputted as a signal of the multiple channel which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal and said clock signal Said optical transmitter is equipped with the signal multiplex section. Said optical receiver Optical parallel transmission characterized by constituting the logical circuit which is equipped with the signal separation section and constitutes said signal multiplex section and the signal separation section from a circuit which operates by clock frequency f=B [Hz] equal to transmission-speed [of an input signal] B [bit/s].
[Claim 2] In an optical transmitter, the clock signal of frequency f [Hz] and the signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with said clock signal are considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission outputted as a signal of the multiple channel which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal and said clock signal Said optical transmitter is equipped with the signal multiplex section which consists of two or more latch means and at least one signal selection means. Said optical receiver Optical parallel transmission characterized by having the signal separation section which consists of two or more latch means, and constituting said signal multiplex section and the signal separation section from the latch means and the signal selection means which all the frequencies of a clock signal required for latch actuation and signal selection actuation are f=B [Hz].
[Claim 3] In an optical transmitter, the clock signal of frequency f [Hz] and the signal of 2-N multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with said clock signal are considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission outputted as a signal of 2-N multiple channel of transmission-speed B=f [bit/s] which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal of frequency f [Hz], and said clock signal said optical transmitter The 1st latch means which it has the signal multiplex section, and said optical receiver is equipped with the signal separation section, and latches the signal of N individual for said signal multiplex section in falling of the clock signal of frequency f=B [Hz] among the signals of 2-N multiple channel, The 2nd latch means which latches the signal of a remaining N individual in falling of said clock signal, The output of N individual of said 2nd latch means with the 3rd latch means latched in the standup of said clock signal, and the high level and low level of said clock signal The output of N individual of said 1st latch means and the output of N individual of said 3rd latch means are chosen by turns. Constitute from a signal selection means to output the signal of N individual of transmission-speed 2xB [bit/s], and 2:1 multiplex actuation is performed. The inside of signal 2-N piece 1a obtained [N / the signal 1 of N individual of transmission-speed 2xB [bit/s] -] by two by branching in said signal separation section,

respectively, 1 b-Na, and Nb, The 4th latch means which latches signal 1 b-Nb in falling of the clock signal of frequency f=B [Hz], Optical parallel transmission characterized by constituting from the 5th latch means which latches signal 1 a-Na in the standup of said clock signal, and the 6th latch means which latches the output of said 5th latch means in falling of said clock signal, and performing 1:2 separation actuation.
[Claim 4] In an optical transmitter, the clock signal of frequency f [Hz] and the signal of 2-N multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with said clock signal are considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission outputted as a signal of 2-N multiple channel of transmission-speed B [bit/s] which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal of frequency f [Hz], and said clock signal said optical transmitter The 1st latch means which it has the signal multiplex section, and said optical receiver is equipped with the signal separation section, and latches the signal of N individual for said signal multiplex section in falling of the clock signal of frequency f=B [Hz] among the signals of 2-N multiple channel, The 2nd latch means which latches the signal of a remaining N individual in falling of said clock signal, The output of N individual of said 2nd latch means with the 3rd latch means latched in the standup of said clock signal, and the high level and low level of said clock signal The output of N individual of said 1st latch means and the output of N individual of said 3rd latch means are chosen by turns. It constitutes from a signal selection means to output the signal of N individual of transmission-speed 2xB [bit/s]. The inside of signal 2-N piece 1a obtained [N / the signal 1 of N individual of transmission-speed 2 NxB [bit/s] -] by two by branching in said signal separation section, respectively, 1 b-Na, and Nb, The 4th latch means which latches signal 1 b-Nb in falling of the clock signal of frequency f=B [Hz], Optical parallel transmission equipment characterized by constituting from the 5th latch means which latches signal 1 a-Na in the standup of said clock signal, and the 6th latch means which latches the output of said 5th latch means in falling of said clock signal.
[Claim 5] In an optical transmitter, one piece or the clock signal of two or more frequencies f [Hz], The signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with at least one in said clock signal is considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission equipment outputted as a signal of the multiple channel which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal and said clock signal The input-buffer section which consists of two or more input-buffer circuits where an optical transmitter does not exceed the number of input electrical signals, The signal multiplex section which consists of a signal multiplex circuit which does not exceed one half of said numbers of input-buffer circuits, With the light emitting device actuator which consists of a light emitting device actuation circuit with more at least one than said number of signal multiplex circuits It has the light emitting device section which consists of a light emitting device equal to said number of light emitting device actuation circuits. Said input-buffer section, said signal multiplex section, and said light emitting device actuator are the semiconductor integrated circuits formed on the same substrate. Said semiconductor integrated circuit for transmission and said light emitting device section are dedicated into one container, and said optical transmission line is equipped with the optical fiber which does not exceed said luminescence element number. Said optical receiver The photo detector section which consists of two or more photo detectors equal to the number of input lightwave signals, and the signal amplifier which consists of a signal amplifying circuit which does not exceed said light-receiving element number, The signal-decision section which consists of a signal-decision circuit which does not exceed said number of signal amplifying circuits, The signal separation section which consists of a signal separation circuit which does not exceed one half of said numbers of signal-decision circuits, It has the output BA@FFA section which consists of an output-buffer circuit with more at least one than said number of signal separation circuits. Said signal amplifier, said signal-decision section, said signal separation section, and said output-buffer section are the semiconductor integrated circuit formed on the same substrate. Said semiconductor integrated circuit for reception and photo detector section are dedicated into one container. Optical parallel transmission equipment characterized by constituting the logical circuit which constitutes said signal multiplex circuit and a signal separation circuit from a circuit which operates with a clock signal with frequency f=B [Hz] equal to transmission-speed [of an input signal] B [bit/s].

[Claim 6] In an optical transmitter, one piece or the clock signal of two or more frequencies f [Hz], The signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with at least one in said clock signal is considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission equipment outputted as a signal of the multiple channel which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal and said clock signal The input-buffer section which consists of two or more input-buffer circuits where said optical transmitter does not exceed the number of input electrical signals, The signal multiplex section which consists of a signal multiplex circuit which does not exceed one half of said numbers of input-buffer circuits, With the light emitting device actuator which consists of a light emitting device actuation circuit with more at least one than said number of signal multiplex circuits It has the light emitting device section which consists of a light emitting device equal to said number of light emitting device actuation circuits. Said input-buffer section, said signal multiplex section, and said light emitting device actuator are the semiconductor integrated circuits formed on the same substrate. Said semiconductor integrated circuit for transmission and said light emitting device section are dedicated into one container, and said optical transmission line is equipped with the optical fiber which does not exceed said luminescence element number. Said optical receiver The photo detector section which consists of two or more photo detectors equal to the number of input lightwave signals, and the signal amplifier which consists of a signal amplifying circuit which does not exceed said light-receiving element number, The signal-decision section which consists of a signal-decision circuit which does not exceed said number of signal amplifying circuits, The signal separation section which consists of a signal separation circuit which does not exceed one half of said numbers of signal-decision circuits, It has the output BA@FFA section which consists of an output-buffer circuit with more at least one than said number of signal separation circuits. Said signal amplifier, said signal-decision section, said signal separation section, and said output-buffer section are the semiconductor integrated circuit formed on the same substrate. Said semiconductor integrated circuit for reception and said photo detector section are dedicated into one container. Said signal multiplex circuit consists of two or more latch circuits and one selector circuit, and said signal separation section consists of two or more latch circuits. Said latch circuit and selector circuit Optical parallel transmission equipment characterized by being the latch circuit which operates with a clock signal with frequency f=B [Hz] equal to transmission-speed [of an input signal] B [bit/s], and a selector circuit.

[Claim 7] In an optical transmitter, one piece or the clock signal of two or more frequencies f [Hz], The signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with at least one in said clock signal is considered as an electrical signal input. Photo electric translation of these electrical signals is carried out, it sends out as a lightwave signal, and said sent-out lightwave signal is transmitted to a receiving end in an optical transmission line. In an optical receiver In the optical parallel transmission equipment outputted as a signal of the multiple channel which carried out photo electric translation of the lightwave signal transmitted in said optical transmission line, and carried out juxtaposition synchronization of the acquired electrical signal with the clock signal and said clock signal The input-buffer section which consists of two or more input-buffer circuits where an optical transmitter does not exceed the number of input electrical signals, The signal multiplex section which consists of a signal multiplex circuit which does not exceed one half of said numbers of input-buffer circuits, With the light emitting device actuator which consists of a light emitting device actuation circuit with more at least one than said number of signal multiplex circuits It has the light emitting device section which consists of a light emitting device equal to said number of light emitting device actuation circuits. Said input-buffer section, said signal multiplex section, and said light emitting device actuator are the semiconductor integrated circuits for transmission formed on the same substrate. Said semiconductor integrated circuit for transmission and said light emitting device section are dedicated into one container, and said optical transmission line is equipped with the optical fiber which does not exceed said luminescence element number. Said optical receiver The photo detector section which consists of two or more photo detectors equal to the number of input lightwave signals, and the signal amplifier which consists of a signal amplifying circuit which does not exceed said light-receiving element number, The signal-decision section which consists of a signal-decision circuit which does not exceed said number of signal amplifying circuits, The signal separation section which consists of a signal separation circuit which does not exceed one half of said numbers of signal-decision circuits, It has the output BA@FFA section which consists of an output-

buffer circuit with more at least one than said number of signal separation circuits. Said signal amplifier, said signal-decision section, said signal separation section, and said output-buffer section are the semiconductor integrated circuit for reception formed on the same substrate. Said semiconductor integrated circuit for reception and photo detector section are dedicated into one container. The 1st latch circuit which latches one of the signals a in falling of the clock signal of frequency f=B [Hz] between two signals a and b by which juxtaposition synchronization was carried out in one of the arbitration of two or more of said signal multiplex circuits, The 2nd latch circuit which latches another signal b in falling of said clock signal between said two signals, The 3rd latch circuit which latches the output of said 2nd latch circuit in the standup of said clock signal, It constitutes from a selector circuit which chooses the output of said 1st latch circuit, and the output of said 3rd latch circuit by turns with the high level and low level of said clock signal, and outputs the data signal of transmission-speed 2xB [bit/s]. One of the arbitration of two or more of said signal separation circuits branches the signal of transmission-speed 2xB [bit/s] to two. The 4th latch circuit which latches one of the signals c in falling of the clock signal of frequency f=B [Hz] between two acquired signals c and d, Optical parallel transmission equipment characterized by constituting from the 5th latch circuit which latches Signal d in the standup of said clock signal, and the 6th latch circuit which latches the output of said 5th latch circuit in falling of said clock signal, and performing 2:1 demultiplexing actuation.
[Claim 8] the optical parallel transmission which falls and comes out and constitutes the logical circuit which constitutes said signal multiplex section and the signal separation section in claim 1 from a standup of a clock signal with frequency f=B [Hz] equal to transmission-speed [of an input signal] B [bit/s], or a circuit which operates.
[Claim 9] It is the optical parallel transmission with which said latch means operates in the standup or falling of said clock signal in claim 2.
[Claim 10] the optical parallel transmission equipment which falls and comes out and constitutes the logical circuit which constitutes said signal multiplex circuit and a signal separation circuit in claim 5 from a standup of a clock signal with frequency f=B [Hz] equal to transmission-speed [of an input signal] B [bit/s], or a circuit which operates.
[Claim 11] It is optical parallel transmission equipment which operates in the standup or falling of a clock signal which has frequency f=B [Hz] with said latch circuit equal to transmission-speed [of an input signal] B [bit/s] in claim 6.
[Claim 12] It is optical parallel transmission equipment equipped with the optical waveguide which said optical transmission line turns into from an organic material in claim 7.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to small optical parallel transmission and equipment in which a high throughput transfer is possible especially about the optical parallel transmission equipment which used the juxtaposition synchronous light transmittal mode and this.
[0002]
[Description of the Prior Art] Electric wiring techniques, such as a coaxial cable, are used for the data transfer between the equipment of a current information processor, or between boards. However, since a limitation is produced in improvement in the speed and densification of signal wiring with the conventional electric wiring technique to the data transmission between the equipment of advanced information processors, such as a super parallel computer and a mass communication device, or between boards, the lightwave signal wiring technique using optical fiber optical waveguide is examined. A high throughput transfer by many channelization is possible for the optical parallel transmission equipment which synchronous-transmits the data signal of a multiple channel collectively with a lightwave signal. Since small, a low power, and a high throughput are required, the miniaturization by simple circuitry and low-power-ization are mentioned between the equipment for advanced information-processing-system construction, or to the engine performance of the data transmission unit between boards as a technical technical problem in above-mentioned optical parallel transmission equipment.
[0003] By the mass exchange which can hold the circuit of a transmission-speed 10 Gbit/s class, signal processing is performed per circuit of 2.4G [bit/s] class, and signal processing is performed by 8 bits or 16 bit parallel by the logic LSI for signal processing mounted in each board. Therefore, in consideration of a clock signal or a control signal, about 20 channels are needed in 2.4G [bit/s] extent being required as a throughput, and considering the case where they are 16 bit parallel for the data transmission between equipment or between boards as the number of channels. To such data transmission, the optical parallel transmission equipment with the number of lightwave signal channels of the number of input/output channels and the same number has many light corpuscle children driven, so that there are many input/output channels, manufacture and low-power-izing of a homogeneous light corpuscle child array are difficult for it, and since the volume which an optical I/O connector area occupies according to the number of optical fibers increases, the problem that where of the high density assembly of a board and the miniaturization of optical parallel transmission equipment are difficult produces it.
[0004] The optical parallel transmission equipment equipped with the multiplexing function as shown in drawing 2 as equipment which solves this problem is known. It consists of optical receivers which consist of the optical transmitter with which optical parallel transmission equipment consists of an input terminal, the 4:1 multiplex sections, and the electrical and electric equipment / optical converter in this example, a transmission line which consists of an optical fiber array, and light / electric converter, the 1:4 separation sections and an output terminal. Small and the optical parallel transmission equipment of a high throughput are obtained by multiplexing an input electrical signal, accelerating the transmission speed of the lightwave signal per channel, and reducing the number of light corpuscle children, and optical I/O connector area volume. As equipment equipped with the multiplexing function, the thing of a publication is known in "IEEE TOKYO SECTION Denshi Tokyo, No.33, 81 pages, and 1994", for example. In this example in an optical transmitter four data signals of 700M[bit/s] It performs 4:1 multiplex using the clock signal of 2.8G [Hz] which is 4 times the frequency of the transmission speed generated in the optical transmitter exterior. Five further these 4:1 multiplex sequences are changed into the lightwave signal of five channels with a five-channel integration laser diode. The lightwave signal which transmitted the inside of a multimode fiber

array and was transmitted with the optical receiver in this lightwave signal is changed into an electrical signal by the five-channel integration photodiode array. The clock signal of 2.8G[Hz] generated in the optical receiver exterior performs 1:4 separation, and the electrical signal of five sequences a total of 20 channels is reproduced. That is, by carrying out 4:1 multiplex [of the signal of 20 channels and 700M [bit/s]] with the clock signal of 2.8G[Hz], the cutback of the number of lightwave signal channels is aimed at, and the volume of the optical connecter section or the fiber cable for transmission is reduced.
[0005]
[Problem(s) to be Solved by the Invention] However, in order to carry out 4:1 multiplex [of the input signal], the clock signal of the frequency exceeding the clock frequency within the mass exchange by which optical parallel transmission equipment is used, or a mainframe is required of the conventional example mentioned above. In above-mentioned reference, in order to carry out 4:1 multiplex [of the signal of 700M [bit/s]], the clock of 2.8G[Hz] is supplied from the outside. That is, in the conventional example, in order to realize a multiplexing function, the high-speed clock signal supply source for multiplex must be carried in the board for signal processing on which optical parallel transmission equipment is used, or a high-speed clock signal supply source must be built in optical parallel transmission equipment itself. Consequently, the high-speed clock signal supply source carried out part buildup, and the circuit magnitude of a board or optical parallel transmission equipment had the problem which is said when it comes to high density assembly or the failure of a miniaturization. The object of this invention is to perform small and an optical high throughput parallel transmission by easy circuitry.
[0006]
[Means for Solving the Problem] According to this invention, the optical parallel transmission and the optical parallel transmission equipment which are characterized by to have the signal multiplex section and the signal-separation section by which the optical transmitter and the optical receiver were constituted from logical circuits, such as a latch circuit which operates by clock frequency f=B [Hz] respectively equal to transmission-speed [of an input signal] B [bit/s], and a selector circuit, to the signal input of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with the clock signal of frequency f [Hz] and said clock signal are offered.
[0007] Moreover, according to this invention, the optical parallel transmission and the optical parallel transmission equipment which are characterized by having the signal multiplex section and the signal separation section which consisted of logical circuits, such as a latch circuit which operates in the standup or falling of a clock signal in which an optical transmitter and an optical receiver have frequency f=B [Hz] respectively equal to input signal transmission-speed B [bit/s], and a selector circuit, to a signal input are offered.
[0008] Moreover, according to this invention, the optical parallel transmission equipment using the semiconductor integrated circuit for transmission by which the above-mentioned signal multiplex section and a light emitting device actuator were integrated, and the semiconductor integrated circuit for reception by which the above-mentioned signal separation section, a signal amplifier, and the signal-decision section were integrated is offered to transmission of the signal of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with the clock signal of frequency f [Hz], and said clock signal.
[0009] As opposed to the signal input of the multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with the clock signal of frequency f [Hz], and the clock signal Logical circuits which constitute a signal multiplex circuit, such as a latch circuit and a selector circuit, are made into the circuit which operates with the clock signal of frequency f [Hz]. Demultiplexing actuation is realized by making logical circuits, such as a latch circuit which constitutes a signal separation circuit, into the circuit which operates with the clock signal of frequency f [Hz], without needing the high-speed clock supply source for demultiplexing especially.
[0010] falling and coming out and making a logical circuit into the standup of a clock signal, or the circuit which operates -- especially, the high-speed clock supply source for demultiplexing is not needed, but big demultiplexing actuation of the phase margin is realized.
[0011] As opposed to the signal of 2-N multiple channel of transmission-speed B=f [bit/s] which carried out juxtaposition synchronization with the clock signal of frequency f [Hz], and the clock signal in the signal multiplex circuit Since the signal of N individual is latched in falling of a clock signal, and it latches in the standup which follows falling of a clock signal further after latching the signal of a remaining N individual in falling of a clock signal The phase of the signal latched in the standup of a clock signal is compared with the signal latched in the standup of a clock signal. It is delayed by the amount of [the amount of / of a clock

signal], i.e., a signal, pulse width by 1/2 bit. By choosing these signals by turns with the high level or low level of a clock signal, and outputting the signal of N individual of transmission-speed 2xB [bit/s], 2:1 multiplex actuation is realized by the signal selection means by easy circuitry.
[0012] In a signal separation circuit, the clock signal of frequency f [Hz] and the signal of N individual of transmission-speed 2xB [bit/s] which it is going to separate are received. a signal, in order to reproduce the signal which each dichotomized and was previously arranged in time among two data signals by which 2:1 multiplex was carried out While branched, latch in backward falling which latched the data signal in the standup of a clock signal, and branched another data signal In order to reproduce the signal behind arranged in time among two data signals by which 2:1 multiplex was carried out By latching in falling of a clock signal, the phase relation between signals is the same as that of a multiplex front, and 1:2 separation actuation from which the juxtaposition synchronizing signal with which the clock signal and the phase gathered is obtained can be realized.
[0013] In an optical transmitter, small and optical low cost parallel transmission equipment are realizable by using the signal multiplex circuit to carry, a light emitting device actuation circuit, etc. as the semiconductor integrated circuit formed on the same substrate, and using the signal amplifying circuit carried in an optical receiver, a signal separation circuit, etc. as the semiconductor integrated circuit formed on the same substrate.
[0014] Optical parallel transmission equipment equipped with lightwave signal wiring which can accumulate on the board for signal processing, and can be mass-produced by making an optical transmission line into the optical waveguide of organic materials, such as plastics chosen so that loss might become small to the wavelength of a lightwave signal, and polyimide, is realizable.
[0015]
[Embodiment of the Invention] Hereafter, the example of this invention is explained with reference to a drawing. Drawing 1 is the block diagram of the optical parallel transmission equipment by this invention. In the optical transmitter, the 2-N piece input terminal section 111 for data signals is connected to the input of the input-buffer section 112. The output of the input-buffer section 112 is connected to the input of the signal multiplex section 120. The signal multiplex section consists of 2:1 multiplex circuits of N individual. If one multiplex circuit 120-1 is observed here, two inputs of a multiplex circuit are connected to the D latch's 121,123 input, respectively. The D latch's 121,123 output is connected to the D latch's 122,124 input. Since reversal KURROKU is supplied to the D latch 122,124, the D latches 121 and 122 and the D latches 123 and 124 become D-FF of a falling edge actuation mold, respectively. The D latch's 124 output is connected to the D latch's 125 input, and both the D latches' 122 and 125 outputs are connected to two inputs of SEKURETA 126. The output of a selector 126 is connected with the output of the signal multiplex section. The output of the signal multiplex section 120 is connected with the input of the electrical and electric equipment / optical converter 130, and the output signal of the signal multiplex section 120 is changed into a lightwave signal by the electrical and electric equipment / optical converter 130, and is transmitted to an optical receiving circuit by using an optical fiber as a transmission medium.
[0016] The input terminal 111-1 for clock signals is connected with the input of an input buffer 112-1, and the output signal is changed into a lightwave signal by the electrical and electric equipment / optical converter 130-1, and is transmitted to an optical receiving circuit by using an optical fiber as a transmission medium while it is supplied to the above-mentioned signal multiplex section.
[0017] In an optical receiver, the transmitted lightwave signal is changed into an electrical signal by light / electric converter 150, and is inputted into the signal separation section 160. The signal separation section consists of 1:2 separation circuits of N individual. If one separation circuit 160-1 is observed here, in the separation circuit, an input dichotomizes and one input is connected with the D latch's 164 input. The D latch's 164 output is connected with the D latch's 165 input, and the D latch's 165 output is connected with the output of a separation circuit. Dichotomous another input is connected with the D latch's 161 input, the D latch's 161 output is connected with the D latch's 162 input, the D latch's 162 output is connected with the D latch's 163 input, and the D latch's 163 output is connected with the output of a separation circuit. By inputting a reversal clock into 163 and 165 as the D latch 161, the D latches 161 and 162 and the D latches 164 and 165 become D-FF of a rising edge and a falling edge actuation mold, respectively. The output of the signal separation section 160 is connected with the input of the output-buffer section 170, and the output of the output-buffer section is connected with the output terminal section 180.
[0018] After the clock signal which was received by light / electric conversion circuit and was changed into the electrical signal is delayed in a delay circuit 166, it is outputted to an output terminal 180-1 through an output buffer 170-1 while an above-mentioned signal separation circuit is supplied. Although the delay

circuit 166 is established in the optical receiver by this example, you may prepare in an optical transmitter.
[0019] Next, the example of a configuration of a multiplex circuit is explained with reference to drawing 3 . The multiplex circuit consists of the 1st D latch 310, the 2nd D latch 320, the 3rd D latch 330, the 4th D latch 340, the 5th D latch 350, and a selector 360. These latch circuits are drawing 1 and support 121, 122, and 123,124,125,126, respectively. In this example, a difference input is inputted for a data signal D0 from the input terminals 301 and 302 of a multiplex circuit, a difference input is inputted for a data signal D1 from input terminals 303 and 304, and a multiple signal Dmux is outputted from the output terminal 305 of a multiplex circuit.
[0020] Next, the example of a configuration of a separation circuit is explained with reference to drawing 4 . A separation circuit consists of the 1st D latch 410, the 2nd D latch 420, the 3rd D latch 430, the 4th D latch 440, and the 5th D latch 450. These are drawing 1 and support 161 and 162,163,164,165, respectively. In this example, the difference input of the data signal Dmux multiplexed from the input terminals 401 and 402 of a separation circuit is carried out, and a data signal D1 is outputted for a data signal D0 from an output terminal 404 from the output terminal 403 of a separation circuit, respectively.
[0021] Next, actuation of the multiplex circuit in this example and a separation circuit is explained using drawing 1 and drawing 5 to the case where the number of signals is 2.
[0022] In a multiplex circuit, the input data signals D0 and D1 of transmission-speed B [bit/s] whose phase generally does not correspond are latched by the D latch 121,122 and the D latch 123,124 in falling of a clock signal, respectively, and a phase is arranged. Next, since a data signal D1 is latched by the D latch 125 in the standup of a clock signal, it is behind [D0] in a phase by 1/2 bit. Since the output of these D latch 123 and the D latch 125 is outputted by the selector 126 according to the high level and low level of a clock signal, 2:1 good multiplex functions are realized. In a separation circuit, after the multiplexed input signal branches to two signals, one data signal is latched in falling of a clock signal so that D1 of two multiplexed signals may be reproduced by the D latches 164 and 165. Another data signal is latched in the standup of a clock signal so that the inside D0 of two multiplexed signals may be reproduced by the D latches 161 and 162. From the D latch's 165 output signal D1, since the phase is progressing by 1/2 bit, by latching the D latch's 162 output signal in falling of a clock signal using the D latch 163 further, two signals D0 and D1 with which the phase gathered are reproduced, and, as for the D latch's 162 output signal D0, 1:2 good isolation is realized. Here, although demultiplexing actuation was explained about the case where the number of signals is 2, the same demultiplexing function is realized by the demultiplexing circuit of N individual also to 2-N data signal.
[0023] At this example, although the circuit by the bipolar transistor was shown as an example of a configuration of a demultiplexing circuit, the same logical circuit may be realized by the CMOS circuit.
[0024] Next, the explanatory view of the optical parallel transmission equipment by this invention is shown in drawing 6 . The optical transmitter carries the semiconductor integrated circuit 612 in which the input-buffer section, the signal multiplex section, and a light emitting device actuator were formed on the same substrate, and the laser diode array 613 in the interior of the metal package 611 with the small thermal resistance equipped with the electrical signal input terminal 614. The electrical signal input terminal 614, a semiconductor integrated circuit 612 and a semiconductor integrated circuit 612, and the laser diode array 613 are connected electrically, respectively. As for the configuration of the electrical signal input terminal 614, the objects for data are [18 and the objects for clocks of 2 and others] objects for signal controls, such as an object for power sources, an object for touch-down, and a shutdown. The data signal of 18 channels and the clock signal of two channels which were inputted from the electrical signal input terminal 614 are sent out by the semiconductor integrated circuit 612 and the laser diode array 613 which built in 2:1 multiplexing circuits as a lightwave signal of nine channels for data, one channel for clocks, and a total of ten channels. The SHINGU mode optical fiber array 617 which is a transmission line is being fixed to the package 611 with the optical fiber folder 618 and the resin 616 for optical fiber immobilization, and optical coupling with the laser diode array 613 is made by the small lens array 615. The optical receiver carries the semiconductor integrated circuit 622 in which the photodiode array 623, a signal amplifier and the signal-decision section, the signal separation section, and the output-buffer section were formed on the same substrate in the interior of the package 621 equipped with the electrical signal output terminal 624 like the optical transmitter. The photodiode array 623, a semiconductor integrated circuit 622 and a semiconductor integrated circuit 622, and the electrical signal output terminal 624 are connected electrically, respectively. As for the configuration of the electrical signal output terminal 624, the object for data is [18 and the object for clocks of 2 and others] an object for power sources, and an object for touch-down. With the semiconductor integrated circuit 622 which carried out the internal organs of the photodiode array 623 and

the 1:2 separation circuits, it is reproduced as the data signal of 18 channels, and a clock signal of two channels, and the lightwave signal of ten channels transmitted in the optical fiber array 617 is outputted from the electrical signal output terminal 624.

[0025] As a light emitting device, as a laser diode and a photo detector, a light emitting diode may be used as a photodiode and a light emitting device, and an avalanche photodiode may be used as a photo detector in this example.

[0026] In this example, although the single mode optical fiber was used as a transmission line, a multimode optical fiber may be used.

[0027] In this example, although the optical fiber was used as a transmission line, optical waveguide made from oxide crystals, polyimide, etc., such as a quartz and a lithium NAIO bait, may be used.

[0028]

[Effect of the Invention] According to this invention, the remarkable effectiveness that the external high-speed clock supply source and clock multiplying circuit which were the conventional configuration become unnecessary is acquired by establishing a multiplex circuit and a separation circuit in optical parallel transmission equipment, and constituting a multiplex circuit and a separation circuit only from the latch circuit and selector which operate with the clock signal of a frequency equal to a data transmission rate. That is, the circuit magnitude of an optical transceiver machine is reduced and small, a low power, and an optical high throughput parallel transmission become possible.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 6]

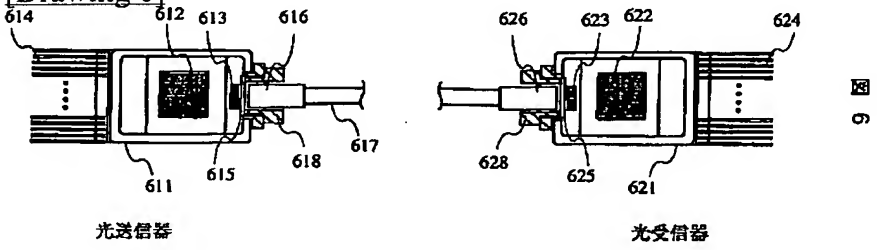


図 6

[Drawing 1]

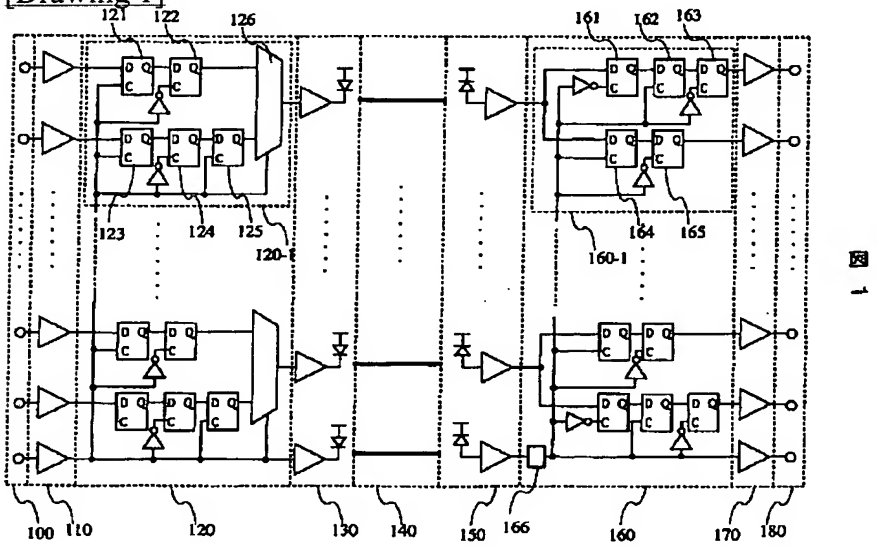


図 1

[Drawing 2]

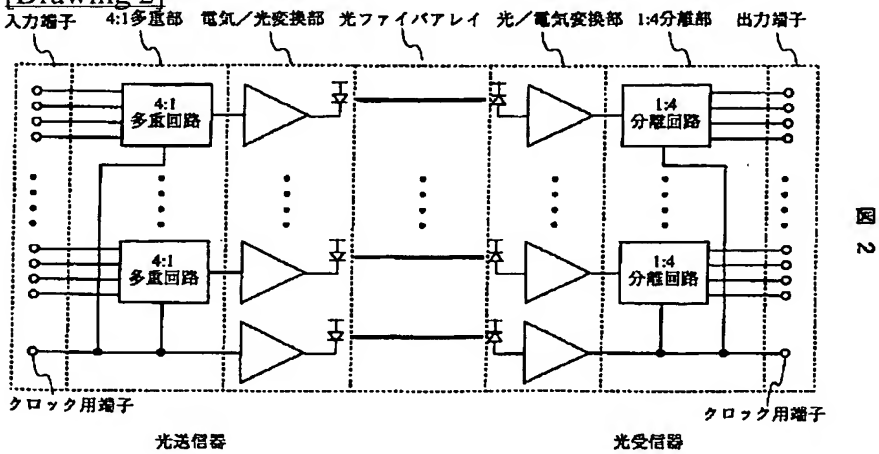
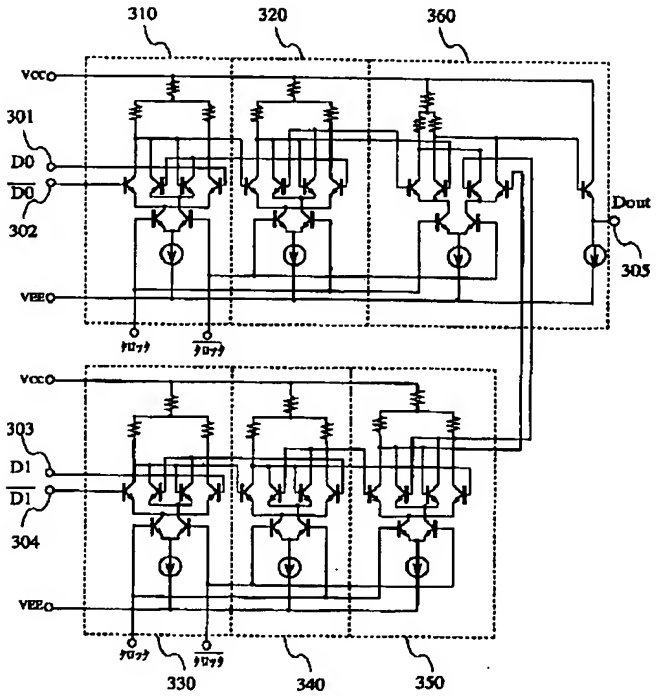


図 2

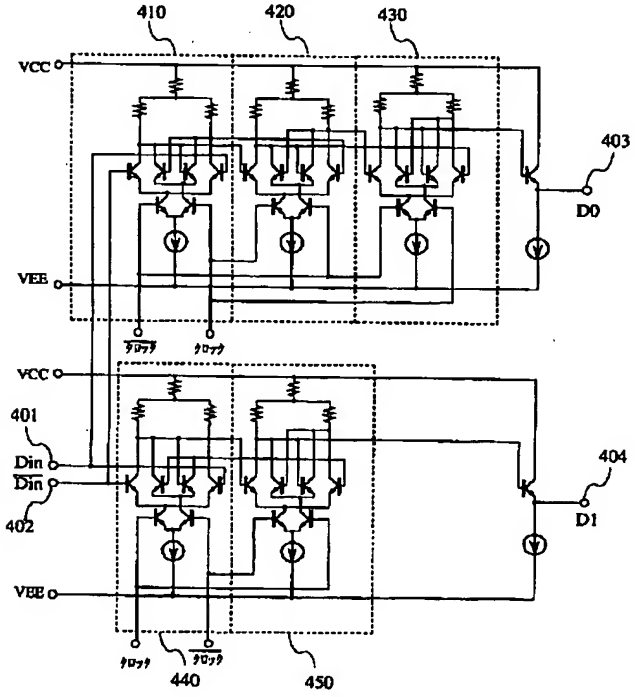
[Drawing 3]

図 3



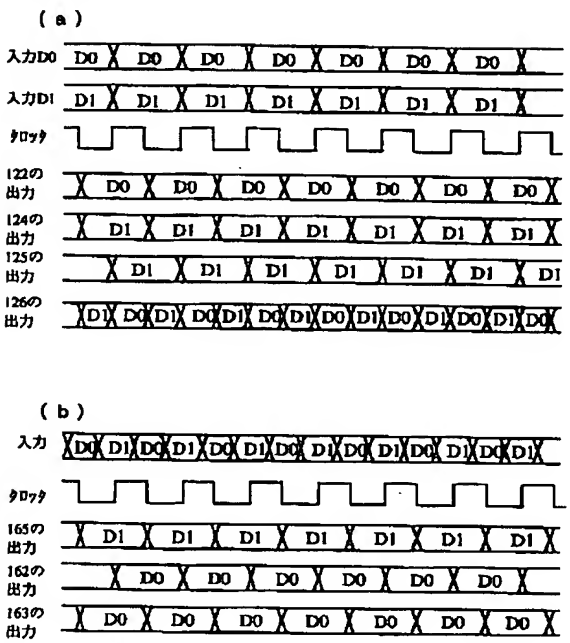
[Drawing 4]

図 4



[Drawing 5]

図 5



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号

特開平9－200167

(43)公開日　平成９年(1997)７月31日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｈ０４Ｊ　3/00			Ｈ０４Ｊ　3/00	Ｑ	
Ｈ０４Ｂ　10/02			3/04	Ｚ	
Ｈ０４Ｊ　3/04			Ｈ０４Ｌ　7/08	Ｚ	
Ｈ０４Ｌ　7/08			Ｈ０４Ｂ　9/00	Ｈ	

審査請求　未請求　請求項の数12　ＯＬ　（全９頁）

(21)出願番号　特願平8－6312

(22)出願日　平成８年(1996)１月18日

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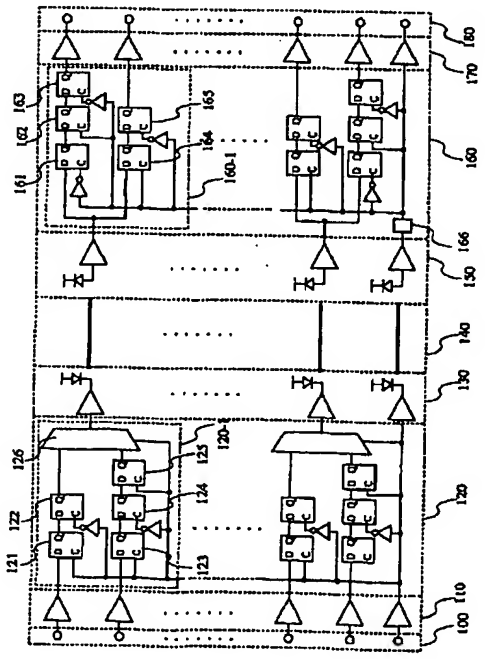
(54)【発明の名称】　光並列伝送方式及び装置

(57)【要約】

【課題】本発明の目的は、入力信号の伝送速度を超えた周波数を持つ高速クロック信号を必要としない多重化機能を備えた小型且つ高スループットな光並列伝送装置を提供することにある。

【解決手段】光送信器１２０及び光受信器１６０にそれぞれ内蔵される多重回路１２０及び分離回路１６０は、入力信号の伝送速度に等しい周波数のクロック信号で動作するラツチ回路１２１～１２５，１６１～１６５及びセレクタ回路１２６で構成される。

図１



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【特許請求の範囲】

【請求項１】光送信器では、周波数ｆ［Hz］のクロック信号と、前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号をクロック信号と前記クロック信号と並列同期化した複数チャネルの信号として出力する光並列伝送方式において、前記光送信器は、信号多重部を備え、前記光受信器は、信号分離部を備え、前記信号多重部および信号分離部を構成する論理回路を、入力信号の伝送速度Ｂ［bit/s］に等しいクロック周波数ｆ＝Ｂ［Hz］で動作する回路で構成することを特徴とする光並列伝送方式。

【請求項２】光送信器では、周波数ｆ［Hz］のクロック信号と、前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号をクロック信号と前記クロック信号と並列同期化した複数チャネルの信号として出力する光並列伝送方式において、前記光送信器は、複数のラッチ手段と少なくとも一つの信号選択手段とからなる信号多重部を備え、前記光受信器は、複数のラッチ手段からなる信号分離部を備え、前記信号多重部および信号分離部を、ラッチ動作及び信号選択動作に必要なクロック信号の周波数が全てｆ＝Ｂ［Hz］であるラッチ手段及び信号選択手段で構成することを特徴とする光並列伝送方式。

【請求項３】光送信器では、周波数ｆ［Hz］のクロック信号と、前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の２Ｎ個の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号を周波数ｆ［Hz］のクロック信号と前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の２Ｎ個の複数チャネルの信号として出力する光並列伝送方式において、前記光送信器は、信号多重部を備え、前記光受信器は、信号分離部を備え、前記信号多重部を、２Ｎ個の複数チャネルの信号のうち、Ｎ個の信号を周波数ｆ＝Ｂ［Hz］のクロック信号の立ち下がりでラッチする第１のラッチ手段と、残りＮ個の信号を前記クロック信号の立ち下がりでラッチする第２のラッチ手段と、前記第２のラッチ手段のＮ個の出力を前記クロック信号の立ち上がりでラッチする第３のラッチ手段と、前記クロック信号のハイレベル及びローレベルで、前記第１のラッチ手段のＮ個

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の出力と前記第３のラッチ手段のＮ個の出力を交互に選択して、伝送速度２×Ｂ［bit/s］のＮ個の信号を出力する信号選択手段とで構成して２：１多重動作を行い、前記信号分離部を、伝送速度２×Ｂ［bit/s］のＮ個の信号１～Ｎをそれぞれ二つに分岐して得られた２Ｎ個の信号１ａ，１ｂ～Ｎａ，Ｎｂのうち、信号１ｂ～Ｎｂを周波数ｆ＝Ｂ［Hz］のクロック信号の立ち下がりでラッチする第４のラッチ手段と、信号１ａ～Ｎａを前記クロック信号の立ち上がりでラッチする第５のラッチ手段と、前記第５のラッチ手段の出力を前記クロック信号の立ち下がりでラッチする第６のラッチ手段とで構成して１：２分離動作を行うことを特徴とする光並列伝送方式。

【請求項４】光送信器では、周波数ｆ［Hz］のクロック信号と、前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の２Ｎ個の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号を周波数ｆ［Hz］のクロック信号と前記クロック信号と並列同期化した伝送速度Ｂ［bit/s］の２Ｎ個の複数チャネルの信号として出力する光並列伝送方式において、前記光送信器は、信号多重部を備え、前記光受信器は、信号分離部を備え、前記信号多重部を、２Ｎ個の複数チャネルの信号のうち、Ｎ個の信号を周波数ｆ＝Ｂ［Hz］のクロック信号の立ち下がりでラッチする第１のラッチ手段と、残りＮ個の信号を前記クロック信号の立ち下がりでラッチする第２のラッチ手段と、前記第２のラッチ手段のＮ個の出力を前記クロック信号の立ち上がりでラッチする第３のラッチ手段と、前記クロック信号のハイレベル及びローレベルで、前記第１のラッチ手段のＮ個の出力と前記第３のラッチ手段のＮ個の出力を交互に選択して、伝送速度２×Ｂ［bit/s］のＮ個の信号を出力する信号選択手段とで構成し、前記信号分離部を、伝送速度２Ｎ×Ｂ［bit/s］のＮ個の信号１～Ｎをそれぞれ二つに分岐して得られた２Ｎ個の信号１ａ，１ｂ～Ｎａ，Ｎｂのうち、信号１ｂ～Ｎｂを周波数ｆ＝Ｂ［Hz］のクロック信号の立ち下がりでラッチする第４のラッチ手段と、信号１ａ～Ｎａを前記クロック信号の立ち上がりでラッチする第５のラッチ手段と、前記第５のラッチ手段の出力を前記クロック信号の立ち下がりでラッチする第６のラッチ手段とで構成することを特徴とする光並列伝送装置。

【請求項５】光送信器では、１個または複数個の周波数ｆ［Hz］のクロック信号と、前記クロック信号のうち少なくとも１個と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光

受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号をクロック信号と前記クロック信号と並列同期化した複数チャネルの信号として出力する光並列伝送装置において、光送信器は、入力電気信号数を超えない複数の入力バッファ回路からなる入力バッファ部と、前記入力バッファ回路数の１／２を超えない信号多重回路からなる信号多重部と、前記信号多重回路数より少なくとも一つ多い発光素子駆動回路からなる発光素子駆動部と、前記発光素子駆動回路数に等しい発光素子からなる発光素子部を備え、前記入力バッファ部と前記信号多重部と前記発光素子駆動部は同一の基板上に形成された半導体集積回路であって、前記送信用半導体集積回路と前記発光素子部は１個の容器中に納められており、前記光伝送路は前記発光素子数を超えない光ファイバを備え、前記光受信器は、入力光信号数に等しい複数の受光素子からなる受光素子部と、前記受光素子数を超えない信号増幅回路からなる信号増幅部と、前記信号増幅回路数を超えない信号識別回路からなる信号識別部と、前記信号識別回路数の１／２を超えない信号分離回路からなる信号分離部と、前記信号分離回路数より少なくとも一つ多い出力バッファ回路からなる出力バッファ部とを備え、前記信号増幅部と前記信号識別部と前記信号分離部と前記出力バッファ部は同一の基板上に形成された半導体集積回路であって、前記受信用半導体集積回路と受光素子部が１個の容器中に納められており、前記信号多重回路および信号分離回路を構成する論理回路を、入力信号の伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号で動作する回路で構成することを特徴とする光並列伝送装置。

【請求項６】光送信器では、１個または複数個の周波数ｆ［Hz］のクロック信号と、前記クロック信号のうち少なくとも１個と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号をクロック信号と前記クロック信号と並列同期化した複数チャネルの信号として出力する光並列伝送装置において、前記光送信器は、入力電気信号数を超えない複数の入力バッファ回路からなる入力バッファ部と、前記入力バッファ回路数の１／２を超えない信号多重回路からなる信号多重部と、前記信号多重回路数より少なくとも一つ多い発光素子駆動回路からなる発光素子駆動部と、前記発光素子駆動回路数に等しい発光素子からなる発光素子部を備え、前記入力バッファ部と前記信号多重部と前記発光素子駆動部は同一の基板上に形成された半導体集積回路であって、前記送信用半導体集積回路と前記発光素子部が１個の容器中に納められており、前記光伝送路は前記発光素子数を超えない光ファイバを備え、前記光受信器は、入力光信号数に等しい複数の受光素子からなる受光素子部と、前記受光素子数を超えない信号増幅回路からなる信号増幅部と、前記信号増幅回路数を超えない信号識別回路からなる信号識別部と、前記信号識別回路数の１／２を超えない信号分離回路からなる信号分離部と、前記信号分離回路数より少なくとも一つ多い出力バッファ回路からなる出力バッファ部とを備え、前記信号増幅部と前記信号識別部と前記信号分離部と前記出力バッファ部は同一の基板上に形成された半導体集積回路であって、前記受信用半導体集積回路と受光素子部が１個の容器中に納められており、前記信号多重回路は複数のラッチ回路と１個のセレクタ回路で構成され、前記信号分離部は複数のラッチ回路で構成され、前記ラッチ回路及びセレクタ回路は、入力信号の伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号で動作するラッチ回路及びセレクタ回路であることを特徴とする光並列伝送装置。

【請求項７】光送信器では、１個または複数個の周波数ｆ［Hz］のクロック信号と、前記クロック信号のうち少なくとも１個と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号とを電気信号入力とし、これらの電気信号を光電変換して光信号として送出し、光伝送路では前記送出された光信号を受信端まで伝送し、光受信器では、前記光伝送路を伝送された光信号を光電変換し、得られた電気信号をクロック信号と前記クロック信号と並列同期化した複数チャネルの信号として出力する光並列伝送装置において、光送信器は、入力電気信号数を超えない複数の入力バッファ回路からなる入力バッファ部と、前記入力バッファ回路数の１／２を超えない信号多重回路からなる信号多重部と、前記信号多重回路数より少なくとも一つ多い発光素子駆動回路からなる発光素子駆動部と、前記発光素子駆動回路数に等しい発光素子からなる発光素子部を備え、前記入力バッファ部と前記信号多重部と前記発光素子駆動部は同一の基板上に形成された送信用半導体集積回路であって、前記送信用半導体集積回路と前記発光素子部は１個の容器中に納められており、前記光伝送路は前記発光素子数を超えない光ファイバを備え、前記光受信器は、入力光信号数に等しい複数の受光素子からなる受光素子部と、前記受光素子数を超えない信号増幅回路からなる信号増幅部と、前記信号増幅回路数を超えない信号識別回路からなる信号識別部と、前記信号識別回路数の１／２を超えない信号分離回路からなる信号分離部と、前記信号分離回路数より少なくとも一つ多い出力バッファ回路からなる出力バッファ部とを備え、前記信号増幅部と前記信号識別部と前記信号分離部と前記出力バッファ部は同一の基板上に形成された受信用半導体集積回路であって、前記受信用半導体集積回路と受光素子部が１個の容器中に納められており、前記複数の信号多重回路の任意の１個を、並列同期化された２個の信号ａ，ｂのうち、どちらか一方の信号ａを周波数ｆ＝Ｂ［Hz］のクロック信号の立ち

下がりでラッチする第１のラッチ回路と、前記２個の信号のうちもう一方の信号ｂを前記クロック信号の立ち下がりでラッチする第２のラッチ回路と、前記第２のラッチ回路の出力を前記クロック信号の立ち上がりでラッチする第３のラッチ回路と、前記第１のラッチ回路の出力と前記第３のラッチ回路の出力を、前記クロック信号のハイレベル及びローレベルで交互に選択して伝送速度２×Ｂ［bit/s］のデータ信号を出力するセレクタ回路とで構成し、前記複数の信号分離回路の任意の１個は、伝送速度２×Ｂ［bit/s］の信号を二つに分岐し、得られた２個の信号ｃ，ｄのうち、どちらか一方の信号ｃを周波数ｆ＝Ｂ［Hz］のクロック信号の立ち下がりでラッチする第４のラッチ回路と、信号ｄを前記クロック信号の立ち上がりでラッチする第５のラッチ回路と、前記第５のラッチ回路の出力を前記クロック信号の立ち下がりでラッチする第６のラッチ回路とで構成して２：１多重分離動作を行うことを特徴とする光並列伝送装置。

【請求項８】請求項１において、前記信号多重部および信号分離部を構成する論理回路を、入力信号の伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号の立ち上がりまたは立ち下がりで動作する回路で構成する光並列伝送方式。

【請求項９】請求項２において、前記ラッチ手段は前記クロック信号の立ち上がりまたは立ち下がりで動作する光並列伝送方式。

【請求項１０】請求項５において、前記信号多重回路および信号分離回路を構成する論理回路を、入力信号の伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号の立ち上がりまたは立ち下がりで動作する回路で構成する光並列伝送装置。

【請求項１１】請求項６において、前記ラッチ回路は入力信号の伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号の立ち上がりまたは立ち下がりで動作する光並列伝送装置。

【請求項１２】請求項７において、前記光伝送路は有機材料からなる光導波路を備えた光並列伝送装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、並列同期光転送方式及びこれを用いた光並列伝送装置に関し、特に小型で且つ高スループット転送可能な光並列伝送方式及び装置に関する。

【０００２】

【従来の技術】現在の情報処理装置の装置間もしくはボード間のデータ転送には、同軸ケーブル等の電気配線技術が用いられている。しかし、超並列計算機や大容量通信装置など高度情報処理装置の装置間もしくはボード間のデータ伝送に対して、従来の電気配線技術では、信号配線の高速化・高密度化に限界を生じるため、光ファイバ光導波路を用いた光信号配線技術が検討されている。

複数チャネルのデータ信号を光信号で一括して同期転送する光並列伝送装置は、多チャンネル化により高スループット転送可能である。高度情報処理システム構築のための装置間もしくはボード間データ伝送装置の性能には、小型、低消費電力且つ高スループットが要求されるため、上述の光並列伝送装置での技術課題として、簡素な回路構成による小型化、低消費電力化が挙げられる。

【０００３】伝送速度１０Gbit/sクラスの回線を収容可能な大容量交換機では、２．４Ｇ［bit/s］クラスの回線単位で信号処理が行われ、各ボードに実装される信号処理用論理ＬＳＩでは８ビットもしくは１６ビットパラレルで信号処理が行われる。従って装置間もしくはボード間のデータ伝送には、スループットとして２．４Ｇ［bit/s］程度が必要であり、また１６ビットパラレルの場合を考えるとチャネル数としてクロック信号や制御信号を考慮して２０チャネル程度が必要となる。こうしたデータ伝送に対して、入出力チャネル数と同数の光信号チャネル数を持つ光並列伝送装置は、入出力チャネル数が多いほど駆動する光素子数も多く、均質な光素子アレイの製造や低消費電力化が困難であり、また光ファイバ数に応じて光入出力コネクタ部の占める容積が増加するためボードの高密度実装や光並列伝送装置の小型化が困難であるという問題が生じる。

【０００４】この問題を解決する装置として、図２に示したような多重化機能を備えた光並列伝送装置が知られている。この例で光並列伝送装置は、入力端子と４：１多重部と電気／光変換部とからなる光送信器と、光ファイバアレイからなる伝送路と、光／電気変換部と１：４分離部と出力端子とからなる光受信器で構成されている。入力電気信号を多重化しチャネル当たりの光信号の伝送速度を高速化して、光素子数及び光入出力コネクタ部容積を削減することにより、小型且つ高スループットの光並列伝送装置が得られる。多重化機能を備えた装置としては、例えば「ＩＥＥＥ　ＴＯＫＹＯ　ＳＥＣＴＩＯＮ　Ｄｅｎｓｈｉ　Ｔｏｋｙｏ，Ｎｏ．３３，８１頁、１９９４年」に記載のものが知られている。この例において、光送信器では７００Ｍ［bit/s］のデータ信号４チャネルを、光送信器外部で生成した伝送速度の４倍の周波数である２．８Ｇ［Hz］のクロック信号を用いて４：１多重を行い、さらにこの４：１多重の５系列分を５チャネル集積化レーザダイオードにより５チャネルの光信号に変換し、この光信号をマルチモードファイバアレイ中を伝送し、光受信器では伝送された光信号を５チャネル集積化フォトダイオードアレイで電気信号に変換し、光受信器外部で生成した２．８Ｇ［Hz］のクロック信号により１：４分離を行い、５系列分合計２０チャネルの電気信号を再生している。すなわち２０チャネル、７００Ｍ［bit/s］の信号を２．８Ｇ［Hz］のクロック信号により４：１多重することにより、光信号チャネル数の削減を図り、光コネクタ部や伝送用ファイバケーブルの容

積を削減している。

【０００５】

【発明が解決しようとする課題】しかし、上述した従来例で、入力信号を４：１多重するには、光並列伝送装置が用いられる大容量交換機や大型計算機内でのクロック周波数を超える周波数のクロック信号が必要である。上述の参考文献では、７００Ｍ［bit/s］の信号を４：１多重するために、２．８Ｇ［Hz］のクロックを外部から供給している。すなわち、従来例では多重化機能を実現するために光並列伝送装置が用いられる信号処理用ボードに多重用の高速クロック信号供給源を搭載するか、または光並列伝送装置そのものに高速クロック信号供給源を内蔵しなければならない。その結果、ボードもしくは光並列伝送装置の回路規模は高速クロック信号供給源の分増大し、高密度実装もしくは小型化の障害となるという問題があった。本発明の目的は、簡単な回路構成で小型且つ高スループットな光並列伝送を行うことにある。

【０００６】

【課題を解決するための手段】本発明によれば、周波数ｆ［Hz］のクロック信号および前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号入力に対し、光送信器及び光受信器がそれぞれ入力信号の伝送速度Ｂ［bit/s］に等しいクロック周波数ｆ＝Ｂ［Hz］で動作するラッチ回路やセレクタ回路等の論理回路で構成された信号多重部及び信号分離部を備えたことを特徴とする光並列伝送方式及び光並列伝送装置が提供される。

【０００７】また本発明によれば、信号入力に対して、光送信器及び光受信器がそれぞれ入力信号伝送速度Ｂ［bit/s］に等しい周波数ｆ＝Ｂ［Hz］を持つクロック信号の立ち上がりまたは立ち下がりで動作するラッチ回路やセレクタ回路等の論理回路で構成された信号多重部及び信号分離部を備えたことを特徴とする光並列伝送方式及び光並列伝送装置が提供される。

【０００８】また本発明によれば、周波数ｆ［Hz］のクロック信号および前記クロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号の伝送に対し、上記信号多重部と発光素子駆動部が集積化された送信用半導体集積回路と、上記信号分離部と信号増幅部と信号識別部が集積化された受信用半導体集積回路を用いた光並列伝送装置が提供される。

【０００９】周波数ｆ［Hz］のクロック信号およびクロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の複数チャネルの信号入力に対し、信号多重回路を構成するラッチ回路、セレクタ回路等の論理回路を周波数ｆ［Hz］のクロック信号で動作する回路とし、信号分離回路を構成するラッチ回路等の論理回路を周波数ｆ［Hz］のクロック信号で動作する回路とすることにより、特に多重分離用の高速クロック供給源を必要とせずに多重分離動作が実現される。

【００１０】論理回路をクロック信号の立ち上がりまたは立ち下がりで動作する回路とすることにより、特に多重分離用の高速クロック供給源を必要とせず、位相余裕の大きな多重分離動作が実現される。

【００１１】信号多重回路では、周波数ｆ［Hz］のクロック信号およびクロック信号と並列同期化した伝送速度Ｂ＝ｆ［bit/s］の２Ｎ個の複数チャネルの信号に対し、Ｎ個の信号をクロック信号の立ち下がりでラッチし、残りＮ個の信号をクロック信号の立ち下がりでラッチされた後さらにクロック信号の立ち下がりに続く立ち上がりでラッチするので、クロック信号の立ち上がりでラッチされた信号の位相はクロック信号の立ち上がりでラッチされた信号に比べ、クロック信号のパルス幅分、つまり信号の１／２ビット分遅延され、信号選択手段ではクロック信号のハイレベルまたはローレベルでこれら信号を交互に選択して伝送速度２×Ｂ［bit/s］のＮ個の信号を出力することにより、簡単な回路構成で２：１多重動作が実現される。

【００１２】信号分離回路では、周波数ｆ［Hz］のクロック信号および分離しようとする伝送速度２×Ｂ［bit/s］のＮ個の信号に対して、信号それぞれ２分岐し、２：１多重された二つのデータ信号のうち時間的に先に配列された信号を再生するために、分岐した一方のデータ信号をクロック信号の立ち上がりでラッチした後立ち下がりでラッチし、分岐したもう一方のデータ信号は、２：１多重された二つのデータ信号のうち時間的に後に配列された信号を再生するために、クロック信号の立ち下がりでラッチすることにより、信号間の位相関係が多重前と同様で且つクロック信号と位相が揃った並列同期信号が得られる１：２分離動作が実現できる。

【００１３】光送信器では搭載する信号多重回路や発光素子駆動回路等を同一基板上に形成された半導体集積回路とし、光受信器では搭載する信号増幅回路や信号分離回路等を同一基板上に形成された半導体集積回路とすることにより、小型且つ低コストな光並列伝送装置が実現できる。

【００１４】光伝送路を光信号の波長に対して損失が小さくなるよう選択されたプラスチック、ポリイミド等の有機材料の光導波路とすることで、信号処理用ボードに集積可能で且つ量産可能な光信号配線を備えた光並列伝送装置を実現できる。

【００１５】

【発明の実施の形態】以下、本発明の実施例を図面を参照して説明する。図１は本発明による光並列伝送装置のブロック図である。光送信器では、２Ｎ個のデータ信号用入力端子部１１１は入力バッファ部１１２の入力に接続されている。入力バッファ部１１２の出力は信号多重部１２０の入力に接続されている。信号多重部はＮ個の２：１多重回路で構成される。ここで１個の多重回路１

２０－１に注目すると、多重回路の二つの入力はそれぞれDラッチ１２１，１２３の入力に接続されている。Dラッチ１２１，１２３の出力はDラッチ１２２，１２４の入力に接続される。Dラッチ１２２，１２４には反転クッロクが供給されるので、Dラッチ１２１と１２２、Dラッチ１２３と１２４はそれぞれ立ち下がりエッジ動作型のD－FFとなる。Dラッチ１２４の出力はDラッチ１２５の入力に接続され、Dラッチ１２２および１２５の出力は、ともにセクレタ１２６の二つの入力に接続されている。セレクタ１２６の出力は信号多重部の出力と接続されている。信号多重部１２０の出力は電気／光変換部１３０の入力と接続されており、信号多重部１２０の出力信号は電気／光変換部１３０により光信号に変換され、光ファイバを伝送媒体として光受信回路に伝送される。

【００１６】クロック信号用入力端子１１１－１は、入力バッファ１１２－１の入力と接続され、その出力信号は上述の信号多重部に供給されるとともに、電気／光変換部１３０－１により光信号に変換され光ファイバを伝送媒体として光受信回路に伝送される。

【００１７】光受信器では、伝送された光信号が光／電気変換部１５０により電気信号に変換され、信号分離部１６０に入力される。信号分離部はN個の１：２分離回路で構成される。ここで１個の分離回路１６０－１に注目すると、分離回路では、入力が２分岐され、一方の入力はDラッチ１６４の入力と接続されている。Dラッチ１６４の出力はDラッチ１６５の入力と接続され、Dラッチ１６５の出力は分離回路の出力と接続される。２分岐されたもう一方の入力はDラッチ１６１の入力と接続され、Dラッチ１６１の出力はDラッチ１６２の入力と接続され、Dラッチ１６２の出力はDラッチ１６３の入力と接続され、Dラッチ１６３の出力は分離回路の出力と接続される。Dラッチ１６１と１６３と１６５に反転クロックを入力することにより、Dラッチ１６１と１６２、Dラッチ１６４と１６５はそれぞれ立ち上がりエッジ、立ち下がりエッジ動作型のD－FFとなる。信号分離部１６０の出力は出力バッファ部１７０の入力と接続され、出力バッファ部の出力は出力端子部１８０と接続される。

【００１８】光／電気変換回路により受信され電気信号に変換されたクロック信号は遅延回路１６６で遅延された後、上述の信号分離回路に供給されるとともに出力バッファ１７０－１を経て出力端子１８０－１に出力される。本実施例で遅延回路１６６は光受信器に設けてあるが、光送信器に設けても良い。

【００１９】次に多重回路の構成例について図３を参照して説明する。多重回路は、第１のDラッチ３１０、第２のDラッチ３２０、第３のDラッチ３３０、第４のDラッチ３４０、第５のDラッチ３５０およびセレクタ３６０で構成されている。これらのラッチ回路は図１で、それぞれ１２１，１２２，１２３，１２４，１２５，１２６に対応している。この例では多重回路の入力端子３０１および３０２からデータ信号Ｄ０が差動入力が入力され、入力端子３０３および３０４からデータ信号Ｄ１が差動入力が入力され、多重回路の出力端子３０５から多重信号Dmuxが出力される。

【００２０】次に分離回路の構成例について図４を参照して説明する。分離回路は、第１のDラッチ４１０、第２のDラッチ４２０、第３のDラッチ４３０、第４のDラッチ４４０、第５のDラッチ４５０で構成される。これらは図１で、それぞれ１６１，１６２，１６３，１６４，１６５に対応している。この例では、分離回路の入力端子４０１および４０２から多重化されたデータ信号Dmuxが差動入力され、分離回路の出力端子４０３からデータ信号Ｄ０が、出力端子４０４からデータ信号Ｄ１がそれぞれ出力される。

【００２１】次に本実施例中の多重回路及び分離回路の動作について信号数が２の場合に対して図１および図５を用いて説明する。

【００２２】多重回路では、一般に位相が一致していない伝送速度Ｂ［bit/s］の入力データ信号Ｄ０およびＤ１は、それぞれDラッチ１２１，１２２及びDラッチ１２３，１２４により、クロック信号の立ち下がりでラッチされ、位相が揃えられる。次にデータ信号Ｄ１はDラッチ１２５によりクロック信号の立ち上がりでラッチされるため、Ｄ０より１／２ビット分位相が遅れる。これらDラッチ１２３およびDラッチ１２５の出力は、セレクタ１２６によりクロック信号のハイレベルおよびローレベルに応じて出力されるので、良好な２：１多重機能が実現される。分離回路では多重化された入力信号は、二つの信号に分岐された後、一方のデータ信号はDラッチ１６４および１６５により、多重化された２信号のＤ１が再生されるようにクロック信号の立ち下がりでラッチされる。もう一方のデータ信号はDラッチ１６１および１６２により、多重化された２信号のうちＤ０が再生されるようにクロック信号の立ち上がりでラッチされる。Dラッチ１６２の出力信号Ｄ０は、Dラッチ１６５の出力信号Ｄ１より位相が１／２ビット分進んでいるので、Dラッチ１６２の出力信号をさらにDラッチ１６３を用いてクロック信号の立ち下がりでラッチすることにより、位相の揃った２信号Ｄ０，Ｄ１が再生され、良好な１：２分離機能が実現される。ここでは、信号数が２の場合について多重分離動作を説明したが、２Ｎ個のデータ信号に対してもＮ個の多重分離回路により同様の多重分離機能が実現される。

【００２３】本実施例では、多重分離回路の構成例として、バイポーラトランジスタによる回路を示したが、同様の論理回路をＣＭＯＳ回路で実現してもよい。

【００２４】次に本発明による光並列伝送装置の説明図を図６に示す。光送信器は、電気信号入力端子６１４を

備えた熱抵抗の小さい金属製のパッケージ６１１の内部に、入力バッファ部、信号多重部及び発光素子駆動部を同一基板上に形成した半導体集積回路６１２と、レーザダイオードアレイ６１３を搭載している。電気信号入力端子６１４と半導体集積回路６１２、半導体集積回路６１２とレーザダイオードアレイ６１３はそれぞれ電気的に接続されている。電気信号入力端子６１４の構成は、データ用が１８、クロック用が２、その他は電源用、接地用及びシャットダウン等の信号制御用である。電気信号入力端子６１４から入力された１８チャネルのデータ信号と２チャネルのクロック信号は２：１多重化回路を内蔵した半導体集積回路６１２及びレーザダイオードアレイ６１３により、データ用９チャネル、クロック用１チャネル、計１０チャネルの光信号として送出される。伝送路であるシングモード光ファイバアレイ６１７は、光ファイバフォルダ６１８及び光ファイバ固定用樹脂６１６によりパッケージ６１１に固定されており、小型レンズアレイ６１５によりレーザダイオードアレイ６１３との光結合がなされている。光受信器は、光送信器と同様電気信号出力端子６２４を備えたパッケージ６２１の内部に、フォトダイオードアレイ６２３と、信号増幅部、信号識別部、信号分離部及び出力バッファ部を同一基板上に形成した半導体集積回路６２２を搭載している。フォトダイオードアレイ６２３と半導体集積回路６２２、半導体集積回路６２２と電気信号出力端子６２４はそれぞれ電気的に接続されている。電気信号出力端子６２４の構成は、データ用が１８、クロック用が２、その他は電源用、接地用である。光ファイバアレイ６１７を伝送された１０チャネルの光信号は、フォトダイオードアレイ６２３及び１：２分離回路を内臓した半導体集積回路６２２により、１８チャネルのデータ信号と２チャネルのクロック信号として再生され、電気信号出力端子６２４より出力される。

【００２５】本実施例では、発光素子としてレーザダイオード、受光素子としてフォトダイオード、発光素子として発光ダイオード、受光素子としてアバランシェフォトダイオードを用いても良い。

【００２６】本実施例では、伝送路としてシングルモード光ファイバを用いたが、マルチモード光ファイバを用いても良い。

【００２７】本実施例では、伝送路として光ファイバを用いたが、石英、リチウムナイオベート等の酸化物結晶やポリイミド等を材料とする光導波路を用いても良い。

【００２８】

【発明の効果】本発明によれば、光並列伝送装置に多重回路及び分離回路を設け且つ多重回路及び分離回路をデータ伝送速度に等しい周波数のクロック信号で動作するラッチ回路及びセレクタのみで構成することにより、従来の構成であった外部高速クロック供給源やクロック逓倍回路が不要となるという顕著な効果が得られる。すなわち、光送受信器の回路規模が縮小され、小型、低消費電力且つ高スループットな光並列伝送が可能となる。

【図面の簡単な説明】

【図１】本発明の１実施例の構成を示す光並列伝送装置のブロック図。

【図２】従来装置の構成を示すブロック図。

【図３】本発明の実施例で用いる多重回路図。

【図４】本発明の実施例で用いる分離回路図。

【図５】本発明の実施例で用いられる多重分離回路のタイムチャート。

【図６】本発明の１実施例を示す光並列伝送装置の説明図。

【符号の説明】

１２０…信号多重部、
１２０－１…多重回路、
１２１～１２５，１６１～１６５…Ｄラッチ、
１２６…セレクタ、
１３０…電気／光変換部、
１４０…光ファイバ、
１５０…光／電気変換部、
１６０…信号分離部、
１６０－１…分離回路、
１７０…出力バッファ。

【図６】

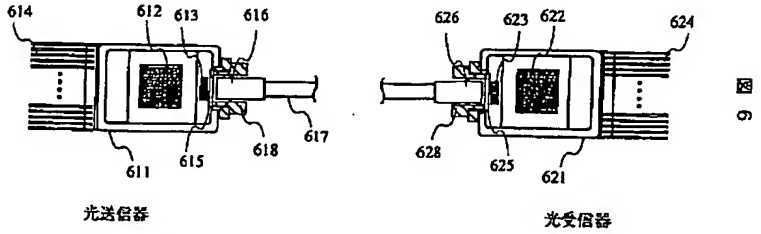


図６

【図１】

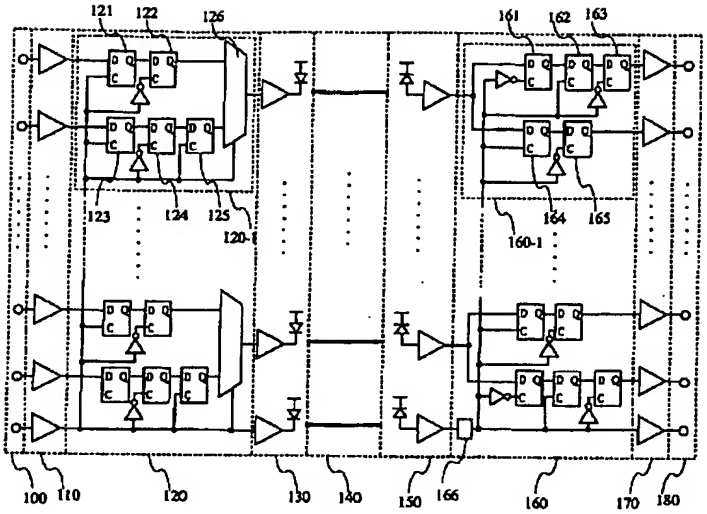

121
122
126
161
162
163
123
124
125
120-1
164
165
160-1
100
110
120
130
140
150
166
160
170
180

図１

【図２】

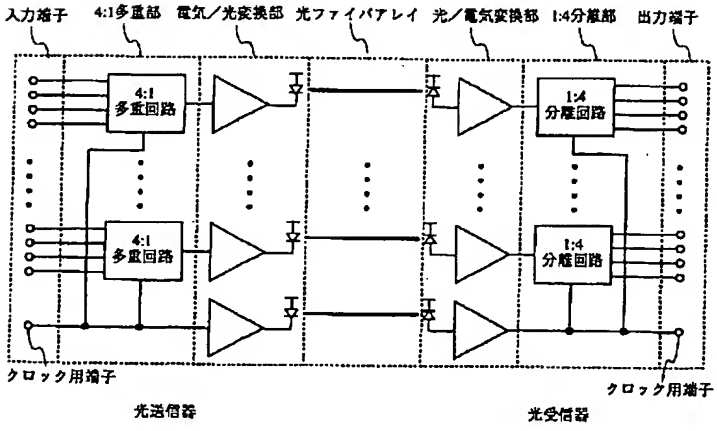
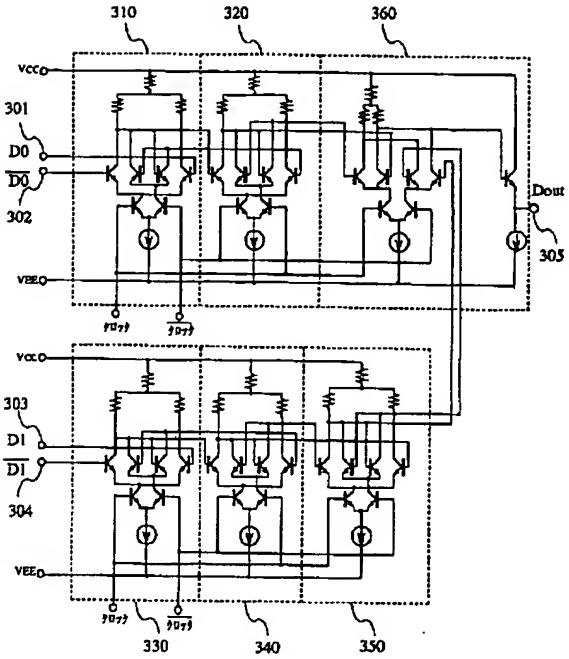

入力端子
4:1多重部
電気／光変換部
光ファイバアレイ
光／電気変換部
1:4分離部
出力端子
4:1
多重回路
4:1
多重回路
1:4
分離回路
1:4
分離回路
クロック用端子
クロック用端子
光送信器
光受信器

図２

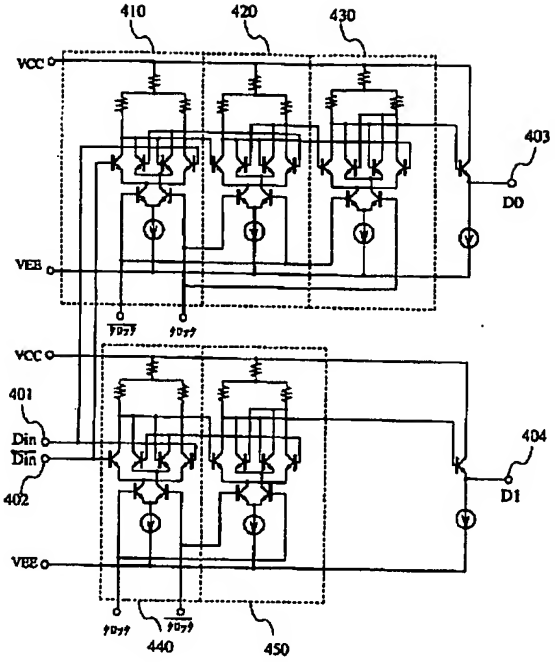
【図３】

図 3



【図４】

図 4



【図５】

図 5